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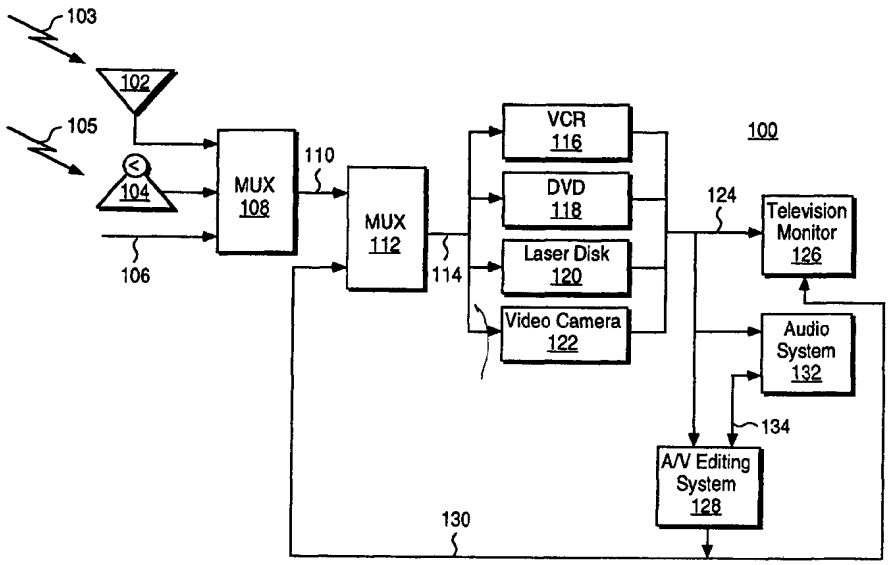

(57) Abstract

A method for editing a video recording includes receiving (124) a signal including video content and analyzing (128) the video content of the received signal to identify visual attributes which characterize the video content. Based, at least in part, on the identified visual attributes of the video content an audio selection (128) with which to augment the received signal is identified from a plurality of available audio selections.

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METHOD AND APPARATUS FOR EDITING A VIDEO RECORDING WITH AUDIO SELECTIONS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to the field of entertainment systems and, in particular, to a method and apparatus for editing a video recording with audio selections.

2. Background Information

Numerous advances have been made in recent years in the field of consumer electronics in general, and entertainment systems in particular. Indeed, many households within the United States now have a television and a video recorder/playback device, e.g., a video cassette recorder, digital versatile disk (a.k.a. digital video disk, or DVD), laser disk players, and the like. In addition, more and more households now have video camera's, also commonly referred to as a "cam-corder", with which to make their own movies, documenting in audio and video, a child's birthday, soccer games, vacations and the like. Similarly, although not entirely replacing "still" pictures, many weddings are now captured on video tape as well as in a photo album.

More advanced models of these prior art video camera's have features, which allow a user to edit and manipulate the recording. For example, some video camera's allow a user to manipulate the recording to add a title, or credits, at the beginning of the recording. Some video camera's permit a user to "fade in/fade out", e.g., slowly focus from a "fuzzy" picture to a clear picture, or from total blackness to a clear picture, and vice versa. Similarly, some of the more advanced video recorder/playback devices include features which allow a user to edit a recording to add a title or credits to a video recording.

None of the foregoing A/V devices, however, allow a user to edit a video recording to add audio content, e.g., a music soundtrack, a poem, sonnet or other

enhancing audio without replacing the original audio content of the video recording. For example, if someone wanted to add background music to their video recording of the ocean, using home A/V equipment typical of the prior art, they would have to re-record the audio track of the video recording, thereby replacing the sound of the ocean with the "background" music, which becomes the primary audio content of the video recording. Those skilled in the art will recognize that an audio "mixer", e.g., a device which receives two signals and combines them into a composite signal, common of professional editing equipment may well solve this dilemma, allowing an editor to augment the video recording with audio. However, audio mixers typical of professional editing systems are expensive, difficult to install and use. That is, audio mixers typical of the prior art require that the user select audio content with which to augment the video recording, the user is required to synchronize the audio selection with the primary audio content, and to set the various levels (e.g., volume) of the audio.

Thus, even if the cost of such a professional mixer were not prohibitively expensive, a typical home entertainment system user would nonetheless find it exceedingly difficult to use a professional audio mixer to edit their home movies. Consequently, although it would be desirable to be able to add background music or other audio effects to home movies, the consumer electronics industry has heretofore failed to satisfy this need.

Thus, a need exists for a method and apparatus for editing a video recording with audio selections that is unencumbered with the foregoing deficiencies and limitations associated with the prior art.

SUMMARY OF THE INVENTION

In accordance with the teachings of the present invention, a method and apparatus for editing a video recording with audio selections is provided. In a first embodiment of the present invention, a method for editing a video recording includes receiving a signal including video content and analyzing the video content of the received

signal to identify visual attributes which characterize the video content. Based, at least in part, on the identified visual attributes of the video content an audio selection with which to augment the received signal is identified from a plurality of available audio selections.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

Figure 1 is a block diagram illustrating an entertainment system incorporating the teachings of the present invention;

Figure 2 is a block diagram of an A/V editing system, in accordance with one embodiment of the present invention;

Figure 3 illustrates a flow chart of one example of a method for automatically augmenting a video recording with an audio selection, in accordance with the teachings of the present invention;

Figure 4 is an illustration of one example of a video channel of a received A/V signal depicting quantization fields used to characterize the visual attributes of the A/V signal, in accordance with one embodiment of the present invention;

Figure 5 illustrates a flow chart of one example of a method for automatically characterizing the primary audio content of a video recording, in accordance with one embodiment of the present invention;

Figure 6 is an illustration of one example of an audio selection database, in accordance with one embodiment of the present invention;

Figure 7 is a block diagram of an example computer system suitable for use as an A/V editing system, in accordance with one embodiment of the present invention; and

Figure 8 is a block diagram illustrating an example software architecture for implementing an A/V editing system, in accordance with one embodiment of the present invention. DETAILED DESCRIPTION

In the following description, for purposes of explanation, specific numbers, materials and configurations are set forth in order to provide a thorough understanding of the present invention. However, it will be apparent to one skilled in the art that the present invention may be practiced without the specific details. In other instances, well known features have been omitted or simplified for ease of explanation. Furthermore, for ease of understanding, certain method steps are delineated as separate steps, however, these separately delineated steps should not be construed as necessarily order dependent in their performance.

Turning to **Figure 1**, a block diagram illustrating one example of an entertainment system incorporating the teachings of the present invention is depicted. In accordance with the illustrated embodiment of **Figure 1**, entertainment system **100** is depicted including audio/video (A/V) editing system **128** incorporating the teachings of the present invention. As will be described in greater detail below, in accordance with one embodiment of the present invention, A/V editing system **128** receives a signal from a video recorder/playback device containing video content within a video stream and, optionally, audio content within an audio stream of the received signal (hereafter generally referred to as an A/V signal), whereupon A/V editing system **128** analyzes the video content of the received A/V signal identifying visual attributes which characterize the video content and, based at least in part on the identified visual attributes, A/V editing system **128** identifies an appropriate audio selection from a plurality of available audio selections with which to augment the received A/V signal. Accordingly, one skilled in the art will appreciate that entertainment system **100** including the innovative A/V editing system **128** provides a user of such an entertainment system with the means to automatically edit and enhance home movies and other video recordings with automatically chosen audio selections.

As depicted in the illustrated example embodiment of **Figure 1**, A/V editing system **128** may well be utilized with a wide variety of A/V components. In accordance with **Figure 1**, entertainment system **100** is shown comprising signal routing multiplexers **108** and **112**, a plurality of video recorder/playback devices, e.g., video cassette recorder/player (VCR) **116**, digital versatile disk (a.k.a. digital video disk, or DVD) **118**, laser disk **120**, video camera **122** and the like, television/monitor **126** and a plurality of audio components cumulatively referenced as audio system **132**, each communicatively coupled within system **100** as depicted in **Figure 1**. Except for A/V editing system **128** incorporated with the teachings of the present invention, each of the elements of system **100** are intended to represent a wide variety of commonly available A/V components and, insofar as their respective functions and features are well known in the art, they need not be further described here.

As illustrated in entertainment system **100** of **Figure 1**, the A/V signal may emanate from any of a number of sources. In the illustrated example embodiment of **Figure 1**, entertainment system **100** is capable of receiving an A/V signal from wireless sources and/or wireline sources. That is, A/V editing system **128** may receive the A/V signal via any of a number of broadcast sources including, for example, television broadcasts **103** received by antenna **102,** or satellite broadcasts **105** received by satellite dish antenna **104**. Similarly, entertainment system **100** also receives A/V signals from wireline sources such as, for example, Internet resources, intranet resources and cable television broadcasts via line **106**. Thus, in accordance with the illustrated embodiment of **Figure 1**, line **106** is intended to represent any of a variety of wireline transport medium including, but not limited to, a plain old telephone services (POTS) line, an Integrated Services Digital Network (ISDN) line, a cable line, an Ethernet line, a T1/E1 line, etc. providing an A/V signal from a corresponding variety of wireline services. Similarly, A/V editing system **128** may receive the A/V signal from any of the plurality of video recorder/playback devices (**116-122**), described above. In an alternate embodiment, television/monitor **126** and A/V editing system **128** may well receive a

broadcast A/V signal directly from the individual antenna/wireline sources, or from MUX **108** via line **110**. Consequently, those skilled in the art will appreciate that system **100** is but an example intended to illustrate the diverse nature of signal sources available to A/V editing system **128**, and that systems of greater or lesser capability may well be substituted without deviating from the spirit and scope of the present invention.

In one embodiment, A/V editing system **128** may be a computer system incorporated with the teachings of the present invention, as will be discussed further with respect to **Figure 7**, below. In another embodiment, A/V editing system **128** may be a "set-top" box endowed with the necessary processing power and incorporated with the teachings of the present invention. Alternatively, A/V editing system **128** may well be incorporated into individual elements within system **100** (e.g., television system, or video cassette recorder). Thus, in accordance with the illustrated example embodiment of **Figure 1**, system **100** is intended to represent any of a number of entertainment systems found in many homes that are capable of receiving an A/V signal from any of a number of alternate sources.

Having introduced the concept of the innovative A/V editing system **128** above within the context of entertainment system **100**, **Figure 2** provides a block diagram which illustrates one example architecture of A/V editing system **200** suitable for use in entertainment system **100**, incorporating the teachings of the present invention. In the illustrated example embodiment of **Figure 2**, A/V editing system **200** is shown comprising video analysis module **202**, audio analysis module **208**, controller **206**, display device **216**, user input device **218** and audio files **212**, each of which being communicatively coupled as depicted. Although audio files **212** are depicted in the illustrated example embodiment of **Figure 2** as being external to controller **206**, those skilled in the art will appreciate that such audio files may well be stored in a mass storage device (not shown) within controller **206**. Further, those skilled in the art will appreciate that in alternate embodiments, audio files **212** may well be located in a

remote location accessible via the Internet and line **106**, or audio files **212** may well be located in an audio system (e.g., audio system **132**), wherein line **214** represents the interconnection between A/V editing system **200** and the audio system. Similarly, in an alternate embodiment, display device **216** may be removed by using television (TV)/monitor **126** as the video display for A/V editing system **200**.

Given the architectural description of the example A/V editing system provided in **Figure 2**, one example method for automatically augmenting a video recording with an audio selection, in accordance with the teachings of the present invention, will be developed with reference to the flow chart depicted in **Figure 3**. In particular, for ease of explanation and not limitation, the operation of A/V editing system **200** will be developed with reference to **Figure 3** and continued reference to **Figure 2**. As illustrated in **Figure 3,** the example method of automatically augmenting a video recording with an audio selection begins with the initial step of determining whether the augmenting function is enabled, step **302**. That is to say, in one embodiment, a user of A/V editing system **200** may disable the audio augmentation feature via user input device **218**. If, in step **302**, it is determined that the audio augmentation feature of A/V editing system **200** has been disabled, the editing session continues without automatic audio augmentation, step **304**.

If, however, the audio augmentation feature of A/V editing system **200** is enabled, A/V editing system **200** loads a predetermined amount of the video recording via an A/V signal for analysis, step **306**. In one embodiment, A/V editing system **200** loads the entire video recording into buffers (not shown) within video analysis module **206** and audio analysis module **208** for analysis and audio augmentation. In an alternate embodiment, A/V editing system **200** loads a subset of the entire video recording for analysis and augmentation. More specifically, in accordance with the latter embodiment, A/V editing system **200** loads two to three minute segments, i.e., samples, of the video recording into the buffers for analysis and augmentation, wherein the length of the sample corresponds to an average length of an audio file in audio files **214**. In

another embodiment, A/V editing system **200** loads individual scenes of the video recording into buffers. In one embodiment, A/V editing system **200** performs an initial analysis of the video recording to identify each of a plurality of scenes comprising the video recording, and incrementally loads individual scenes in the analysis buffer for audio augmentation, to be described more fully below.

Having loaded the predetermined amount of the video recording via an A/V signal for analysis in step **306**, the received A/V signal is simultaneously analyzed by video analysis module **202** and audio analysis module **208**, in steps **308** and **310**, respectively. That is, in accordance with the illustrated embodiment of **Figure 3**, the A/V signal is simultaneously provided to video analysis module **202** which analyzes the video content of the A/V signal, as well as audio analysis module **208** which analyzes the audio content of the A/V signal. In particular, video analysis module **202** analyzes the video content embedded within the video stream of the received A/V signal and characterizes the video content in terms of any of a number of visual attributes, step **308**. In one embodiment, video analysis module **202** "splits" the received video stream into a number of quantization regions, or quadrants, and analyzes the video content within each of the quantization regions of the video stream. One example of a video stream broken into such quantization regions is depicted in the illustration of **Figure 4**.

Jumping ahead to **Figure 4**, an illustration of a video stream with its corresponding quantization regions is depicted. In particular, video stream **400** is shown comprising a number of "frames" (e.g., a predetermined amount of the video stream) of the video stream referenced as **402a**, **402b** through **402n**, respectively. As illustrated in **Figure 4**, the quantization regions of frame **402b** are depicted as quantization region 1 (Q_1) **404a** through quantization region 9 (Q_9) **404n**. Thus, in accordance with one example embodiment of the present invention, video analysis module **202** analyzes the video content within each of the quantization regions of each frame of the video stream to characterize the video content in terms of its visual attributes.

In one embodiment, for example, video analysis module **202** analyzes each of the quantization regions **404a** through **404n** of video stream **400** for color attributes, e.g., whether the video content of the received A/V signal is a "cool" color (blues, whites), a "hot" color (reds, yellows), or a "warm" or "earthy" color (browns, oranges), etc. and output on a scale of 0 ("cool" (white)) to 10 ("hot" (red)), with appropriate gradations in between. In another embodiment, video analysis module **202** analyzes each of the quantization regions **404a** through **404n** of video stream **400** for lighting visual attributes, e.g., whether the video content is "bright" or "dark". In another embodiment, video analysis module **202** analyzes each of the quantization regions **404a** through **404n** of video stream **400** for content and motion visual attributes, e.g., whether the video contains cityscape or a countryside, whether the video contains people and whether they are active or sedentary. One example of a system for quantizing the motion/action within video content is described in copending US Patent Application No. 08/918,681 entitled "Bit-Rate Control of Video Data Compression" by Adnan Allatar, commonly assigned to the assignee of the present invention. In yet another embodiment, video analysis module **202** analyzes quantization regions **404a** through **404n** of video stream **400** for each of the above mentioned visual attributes.

Returning to the illustrated example method depicted in **Figure 2**, in addition to the video analysis of step **308**, audio analysis module **208** analyzes the audio content (hereafter, primary audio content), if any, received in the audio stream of the received A/V signal and identifies audio attribute information which characterizes the primary audio content embedded within the audio stream, step **310**. For the illustrated embodiment, the purpose of identifying audio attribute information in step **310** is to set the level, e.g., volume, of the augmented audio selection thereby ensuring that the primary audio content, if any, is not "smothered" or "drowned out" by the relative level of the augmented audio selection. One example method for analyzing the primary audio content of the received A/V signal (e.g., step **310**) is shown in **Figure 5**.

Referring to **Figure 5**, one example method for analyzing the primary audio content of the received A/V signal is depicted, in accordance with one embodiment of the present invention. In the illustrated example embodiment of **Figure 5**, the audio analysis begins with audio analysis module **208** determining whether the received A/V signal includes an audio stream containing audio content (i.e., primary audio content), step **502**. If audio analysis module **208** determines that the audio stream does not carry any audio content, an indication that the audio selection ultimately chosen by A/V editing system **200** will provide the only audio content for the recording, audio analysis module **208** provides a level indication to controller **206** via line **214**, step **504**. In such a circumstance, the level indication will set the volume of the audio selection chosen by A/V editing system to a "high" level, as it will provide the only audio content for this segment of the video recording. If, however, audio analysis module **208** determines that the received A/V signal does contain audio content, step **502**, audio analysis module **208** next determines whether the primary audio content contains speech, step **506**. In one embodiment, audio analysis module **208** employs any of a number of available speech recognition devices with which to perform this task.

If, in step **506**, audio analysis module **208** determines that the primary audio content consists of speech, audio analysis module **208** issues a level indication to controller **206** via line **214** that ensures the speech will not be drowned out, step **508**. Alternatively, if in step **506** audio analysis module **208** determines that the primary audio content is not speech, a determination is made in step **510** as to whether the primary audio content consists of music. In one embodiment, audio analysis module **208** analyzes the relative levels and breadth of frequency spectrum that characterizes the primary audio content in making this determination. For example, a spectral analysis wherein the primary audio content spans a broad frequency spectrum with large gradients within the spectrum that fluctuate over time, provides an indication that the primary audio content consists of music. In an alternate embodiment, audio

analysis module **208** may be pre-programmed with a number of music selections with which to compare the received primary audio content.

Regardless of the method of analysis, if audio analysis module **208** determines that the primary audio content is not music, step **510**, having already determined that the primary audio content is not speech, audio analysis module **208** determines that the audio selection ultimately chosen by A/V editing system **200** is to be background audio and, consequently, issues a level indication to controller **206** via line **214** to ensure that the primary audio content is not "smothered" by the background audio selection, step **508**, If, however, audio analysis module **208** determines in step **510** that the primary audio content does consist of music, audio analysis module **208** provides this audio attribute information to controller **206** via line **214**. Subsequently, controller **206** prompts the user of A/V editing system **200** via display device **216** with the option of overwriting the primary audio content (e.g., the music). For continuity and ease of explanation only, the function wherein controller **206** provides the user of A/V editing system **200** with this option is presented in the illustrated embodiment of **Figure 5** as step **512**, although those skilled in the art will appreciate that this step may well be completed later in method **300** of **Figure 3**.

If the user elects to overwrite the primary audio content of the received A/V signal, the audio selection chosen by A/V editing system **200** becomes the primary audio content of the composite signal generated by A/V editing system **200** and is, accordingly, set to an appropriate level, step **504**. However, if in step **512**, the user of A/V editing system **200** elects not to override the primary audio content consisting of music, the editing session continues without audio augmentation of this predetermined amount of the received A/V signal, step **514**.

Therefore, in accordance with one embodiment of the present invention, the content of the audio stream is merely analyzed for purposes of setting a level with which to augment the received A/V signal. That is, in the illustrated example embodiment, the function of audio analysis module **208** is to identify the audio

attributes of the primary audio content to ensure that the recording level (e.g., volume) of the augmented audio set by controller **206** does not "smother" the primary audio content. Those skilled in the art will appreciate, however, that in other embodiments, analysis of the audio content may well server additional functions without deviating from the spirit or scope of the present invention.

Continuing with the example method of **Figure 3**, having received visual attribute information from video analysis module **202** in step **308**, controller **206** identifies an appropriate audio selection from a plurality of audio selections contained within audio files **212** based, at least in part, on the received visual attribute information, step **312**. In one embodiment, controller **206** relies on a database which references appropriate audio selections based on any of a number of corresponding visual attributes. One example of a database suitable for use by controller **206** is depicted in **Figure 6**.

In accordance with the illustrated example embodiment of **Figure 6**, database **600** is shown comprising a number of audio selections cross referenced with a number of visual attributes. As depicted in the illustrated example embodiment of **Figure 6**, database **600** references audio selections against corresponding visual attributes in a two-dimensional database. In the illustrated embodiment, the y-axis is characterized by identifying the genre **602** of the audio selections. Those skilled in the art will appreciate that genre information **602** is but one of a number of alternative means by which the information within database **600** may be organized. Thus, a number of suitable alternative approaches exist for organizing the information of database **600**, without departing from the spirit or scope of the present invention.

The x-axis of database **600** is characterized by audio selections **604** cross referenced against corresponding visual attributes such as, for example, color attributes **606**, lighting attributes **608** and content/motion attributes **610**. In accordance with one embodiment of the present invention, A/V editing system **200** may be preloaded with a number of audio selections, wherein the audio selections stored within database **600** are

cross referenced against the various attribute information. In another embodiment, A/V editing system **200** provides a user interface through which audio selections may be added to or deleted from audio files **212**, wherein controller **206** automatically updates database **600** with the additions/deletions, as appropriate. Further, those skilled in the art will appreciate that although database **600** is depicted as a two-dimensional database, this is for ease of explanation only. That is, databases of greater or lessor complexity may be beneficially substituted for database **600**, with a corresponding effect on the amount and complexity of the information contained therein.

Returning to the illustrated embodiment of **Figure 3**, having automatically chosen an audio selection with which to augment the video recording based, at least in part, on the identified visual attributes of the video recording in step **312**, controller **206** prompts the user of A/V editing system **200** with the option of accepting the controllers audio selection, or rejecting it in favor of another selection, step **314**. If, in step **314**, the user accepts the audio selection of controller **206**, controller **206** synchronizes the audio selection with the video recording, mixing the audio selection with the primary audio content, if any, at levels automatically determined by audio analysis module **208**, as appropriate, and outputs a composite signal comprising the received A/V signal augmented with the automatically identified audio selection. In one embodiment, while mixing the automatically identified audio selection with the primary audio content, controller **206** coordinates the "tempo" (e.g., speed) of the audio selection with the rate of motion identified in the video content, or with the tempo of the primary audio content.

If, however, the user rejects the audio selection of controller **206** in step **314**, the user is provided with an interface through which the user can access database **600** of the available audio selections, wherein the user chooses an audio selection with which to augment the video recording, step **316**. In step **318**, controller **206** determines whether the end of the video recording has been reached. If so, the method ends. Alternatively, if controller **206** determines that the end of the video recording has not yet been reached,

the method continues with step **306**, and the next predetermined amount of video for editing is loaded in A/V editing system **200**, as appropriate.

Therefore, in accordance with the teachings of the present invention, A/V editing system **200** analyzes the video content of a received A/V signal and characterizes the video content in terms of a number of visual attributes. Additionally A/V editing system **200** analyzes the audio content of the received A/V signal, e.g., primary audio content, to automatically identify a level at which to "mix" the audio selection with the primary audio content. Having developed the visual attribute information, A/V editing system **200** chooses an audio selection from a plurality of available audio selections based, at least in part, on the identified visual attribute information. Having identified an audio selection with which to augment the primary audio content, upon receiving user approval A/V editing system **200** "mixes" the audio selection with the primary audio content at a level automatically determined in accordance with determined audio attribute information of the audio stream. In accordance with one embodiment of the present invention, the audio selection is a musical composition, e.g., a song. In an alternate embodiment, the audio selection is a poem, a sonnet or another lyrical composition that is automatically selected by A/V editing system **200** to enhance the mood depicted by the visual attributes of the received A/V signal.

In accordance with one embodiment of the present invention, A/V editing system **200** is a computer system appropriately configured to analyze a video stream and characterize the video content of a received A/V signal in terms of its visual attributes and based, at least in part, on those visual attributes the computer system identifies an audio selection with which to augment the received A/V signal, and generates a composite of the received A/V signal and the automatically identified audio selection for recording. As will be described in greater detail below, A/V editing system **200** is intended to represent a broad category of computer systems known in the art. An example of such a computer system is a desktop computer system equipped with a high performance microprocessor(s), such as the Pentium® processor, Pentium® Pro

processor, or Pentium® II processor manufactured by and commonly available from Intel Corporation of Santa Clara, California; including any of a number of audio and video input and output peripherals/interfaces for receiving, digitizing, compressing and decompressing audio and video signals. It is to be appreciated that the housing size and design for A/V editing system **200** may be altered, allowing it to better visually fit within an entertainment system, e.g., entertainment system **100**. Accordingly, A/V editing system **200** may well be embodied within a "set-top" box incorporated with the teachings of the present invention.

Figure 7 provides a block diagram of a computer system (e.g., system **700**) incorporated with the teachings of the present invention. In one embodiment, system **700** is A/V editing system **128** of **Figure 1**. In the illustrated embodiment, system **700** includes at least one processor (e.g., processor **702**) and cache memory **704** coupled to each other as shown. Additionally, system **700** includes high performance input/output (I/O) bus **706** and standard I/O bus **708**, as shown. Host bridge **710** couples processor **702** to high performance I/O bus **706**, whereas I/O bus bridge **712** couples high performance I/O bus **706** to standard I/O bus **708**. Coupled to high performance I/O bus **706** are network/communication interface **724**, system memory **714**, audio/video interface board **730**, A/V editor **732** and video memory **716**. In turn, display device **718** is coupled to video memory **716**. Coupled to standard I/O bus **708** are mass storage device **720** keyboard and pointing device **722**, and I/O ports **726**. In one embodiment, keyboard and pointing device are coupled to standard I/O bus **708** with a serial communication interface cable, while in alternate embodiments it may be communicatively coupled with an infrared (IR) interface or a radio-frequency (RF) interface.

With continued reference to **Figure 7**, elements **702-730** perform their conventional functions as known in the art. In particular, network/communication interface **724** is used to provide communication between system **700** and any of a wide range of conventional networks, such as Ethernet, token ring, the Internet, etc.

Similarly, audio/video interface board **730** is used to receive broadcast communications from any of a wide range of conventional wireline and wireless broadcast media such as RF broadcasts, satellite broadcasts, cable broadcasts, etc. Mass storage device **720** is used to provide permanent storage for the data and programming instructions to implement the above described functions, whereas system memory **714** is used to provide temporary storage for the data and programming instructions when executed by processor **702**. I/O ports **726** are one or more serial and/or parallel communication ports used to provide communication between additional peripheral devices which may be coupled to system **700** (e.g., stereo, speakers, etc.). Collectively, the elements coupled to system **700** are intended to represent a broad category of hardware systems, including but not limited to general purpose computer systems based on the Pentium® processor, the Pentium® Pro processor, or the Pentium® II processor commonly available from Intel Corporation of Santa Clara, California.

In one embodiment, A/V editor **732** includes video analysis module **202** and audio analysis module **208** of A/V editing system **200**, while controller **206**, display device **216** and user interface device **218** of A/V editing system **200** correspond to processor **702**, display device **718** and keyboard and pointing device **722**, respectively, of system **700** of **Figure 7**. In one embodiment, audio files **216** are stored on mass storage **720**, or are remotely located and communicatively coupled to system **700** via network/communication interface **724**. In one embodiment, system **700** receives an A/V signal from network/communication interface **724** and/or audio/video tuner interface **730**, analyzes the video content for visual attribute information, and automatically identifies an audio selection with which to augment the received A/V signal, in accordance with the teachings above. In an alternate embodiment, system **700** receives an A/V signal via an antennae (not shown) coupled to one of I/O ports **726** and automatically identifies an appropriate audio selection with which to augment the received A/V signal.

It is to be appreciated that various components of system **700** may be re-arranged. For example, cache **704** may be on-chip with processor **702**. Alternatively, cache **704** and processor **702** may be packed together as a "processor module", with processor **702** being referred to as the "processor core". Furthermore, mass storage device **720**, keyboard and pointing device **722**, and/or display device **718** and video memory **716** may not be included in system **700**. Additionally, the peripheral devices shown coupled to standard I/O bus **708** may, in alternate embodiments, be coupled to high performance I/O bus **706**; or, in some implementations only a single bus may exist with the components of system **700** being coupled to the single bus. Furthermore, additional components may be included in system **700**, such as additional processors, storage devices, or memories.

In one embodiment, rather than including a separate A/V editor **732**, the innovative features of the present invention discussed above may be implemented as a series of software routines run by system **700** of **Figure 7**. These software routines run a plurality or series of instructions to be executed by a processor, such as processor **702** in system **700**. Initially, the series of instructions are stored on a storage device, such as mass storage device **720**. It is to be appreciated that the series of instructions may be stored on any conventional storage device, such as a diskette, CD ROM, magnetic tape, digital versatile disk (DVD) (also referred to as a digital video disk), laser disk, ROM, flash memory, etc. It is also to be appreciated that the series of instructions need not be stored locally, and could be received from a remote storage device, such as a server on a network, via network/communication interface **724**. The instructions are copied from the storage device, such as mass storage device **720**, into system memory **714** and then accessed and executed by processor **702**. In one embodiment, these software routines are written in the C++ programming language. It is to be appreciated, however, that these routines may be implemented in any of a wide variety of programming languages. In alternate embodiments, the present invention may be implemented in discrete hardware or firmware. For example, an application specific

integrated circuit (ASIC) could be programmed with the above described functions of the present invention.

Figure 8 is a block diagram illustrating the software elements comprising an example software architecture in accordance with one embodiment of the present invention. In particular, example software architecture **800** is shown comprising A/V editor application **802**, A/V editor agent **804** with associated video analysis module **806** and audio analysis module **808,** and an operating system **810** with associated drivers, and BIOS **822**. As depicted in the illustrated example embodiment of **Figure 8**, A/V editor application **802** interfaces with A/V editor agent **804** and provides the user interface for A/V editing system **128** of **Figure 1**.

In one embodiment, A/V editor agent **804** is coupled to and able to obtain information from database **812** and audio files **814**. In an alternate embodiment, audio files **814** and/or database **812** are integrated modules of A/V editor agent **804**. As depicted in **Figure 8**, A/V editor agent **804** receives a video signal through a communication port via an appropriate driver within operating system **810**. In one embodiment, video analysis module **806** performs the steps of analyzing the video content of the received A/V signal for any of a number of visual attributes, while audio analysis module **808** analyzes the audio content of the received A/V signal (e.g., the primary audio content), if any, to determine the relative level (e.g., volume) at which the audio selection is to be recorded, in accordance with the teachings of the present invention described above. Based, at least in part, on input from video analysis module **806** A/V editor **804**, accessing database **812**, identifies an audio selection which substantially corresponds with the identified visual attributes of the video content of the received signal, and upon user approval of the identified audio selection, A/V editor **802** combines the received A/V signal with the identified audio selection, at a level automatically selected by audio analysis module **208**, to provide a composite A/V signal including the augmented audio selection which is output through an appropriate driver of operating system **810**.

As alluded to above, BIOS **822** provides an interface between operating system **810** and the various I/O devices coupled to the hardware system. Operating system **810** is a software service which provides an interface between BIOS **822** and A/V editor agent **804** as well as other software applications, if any, being executed by a computer system within which the present invention is practiced (e.g., system **700**). Operating system **810** provides an interface, such as a graphical user interface (GUI), between the user and the system controller. According to one embodiment of the present invention, operating system **810** is the Windows™ 95 operating system, available from Microsoft Corporation of Redmond, Washington. However, it is to be appreciated that the present invention may be used with any other conventional operating system, such as, for example, other versions of Microsoft Windows™ (for example, Windows™ 3.0, Windows™ 3.1, Windows™ NT, or Windows™ CE), Microsoft DOS, OS/2, available from International Business Machines Corporation of Armonk, New York, the Apple Macintosh Operating System, available from Apple Computer Incorporated of Cupertino, California, the NeXTSTEP® operating system available from Apple Computer Incorporated, or the UNIX operating system, available from Santa Cruz Operations of Santa Cruz, California.

Thus, in accordance with the teachings of the present invention, an A/V editing system analyzes the video content of a video recording and, based at least in part on the visual attributes of the video content, automatically identifies an audio selection with which to augment the video recording, at a recording level automatically selected by the A/V editing system that does not overwhelm the primary audio content, if any, of the video recording.

While the method and apparatus of the present invention has been described in terms of the above illustrated embodiments, those skilled in the art will recognize that the invention is not limited to the embodiments so described. The present invention can be practiced with modification and alteration within the spirit and scope of the appended claims. For example, although depicted as separate components, A/V editing

system **128** may well be incorporated into any of the system components (e.g., a television/monitor/video cassette recorder/playback device) within system **100**. Further, A/V editing system **128** may not include all of the elements depicted in **Figures 2** or **7**, or may, alternatively, include additional elements without deviating from the scope and spirit of the present invention. Accordingly, the description is to be regarded as illustrative instead of restrictive on the present invention.

Thus, a method and apparatus for editing a video recording with audio selections has been described.

CLAIMS

We claim:

1. A machine implemented method comprising:

(a) receiving a signal including video content;

(b) analyzing the video content of the received signal to identify visual attributes of the video content; and

(c) identifying an appropriate audio selection from a plurality of available audio selections with which to augment the received signal based, at least in part, on the identified visual attributes of the video content.

2. The method of claim 1, further comprising:

(d) augmenting the received signal with the identified audio selection to form a composite audio/video (A/V) signal comprising at least the video content and the identified audio selection.

3. The method of claim 1, wherein (b) analyzing the video content of the received signal includes characterizing the video content of the received signal in terms of color visual attributes.

4. The method of claim 1, wherein (b) analyzing the video content of the received signal includes characterizing the video content of the received signal in terms of lighting visual attributes.

5. The method of claim 1, wherein (b) analyzing the video content of the received signal includes characterizing the video content of the received signal in terms of motion visual attributes.

6. The method of claim 1, wherein (b) analyzing the video content of the received signal comprises at least one of:

(b.1) characterizing the video content of the received signal in terms of color visual attributes;

(b.2) characterizing the video content of the received signal in terms of lighting visual attributes; and

(b.3) characterizing the video content of the received signal in terms of motion visual attributes.

7. The method of claim 1, further comprising:

(d) identifying a recording level at which to augment the received signal with the identified audio selection.

8. The method of claim 7, further comprising:

(e) augmenting the received signal with the identified audio selection to form a composite audio/video (A/V) signal comprising at least the video content and the identified audio selection.

9. The method of claim 7, wherein (d) identifying a recording level comprises:

(d.1) determining whether the received signal includes audio content;

(d.2) identifying audio attributes which characterize the audio content, if it is determined that the received signal includes audio content; and

(d.3) selecting a recording level at which to augment the audio content of the received signal with the identified audio selection.

10. An apparatus comprising:

an input port through which the apparatus receives a signal having video content;

a video analysis circuit, coupled to the input port, operative to analyze the video content of the received signal to identify visual attributes of the video content; and

a controller, coupled to the video analysis circuit, operative to identify and retrieve an appropriate audio selection from a plurality of audio selections with which to augment the received signal based, at least in part, on the identified visual attributes of the video content of the received video signal.

11. The apparatus of claim 10, further comprising a mass storage device, coupled to the controller, operative to store and retrieve each of the plurality of audio selections.

12. The apparatus of claim 10, wherein the video analysis circuit is operative to quantify color visual attributes of the video content.

13. The apparatus of claim 10, wherein the video analysis circuit is operative to identify lighting visual attributes of the video content.

14. The apparatus of claim 10, wherein the video analysis circuit is operative to identify motion visual attributes of the video content.

15. The apparatus of claim 10, wherein the video analysis circuit is operative to identify color visual attributes, lighting visual attributes and motion visual attributes of the video content.

16. The apparatus of claim 10, wherein the controller is operative to mix the identified audio selection with primary audio content of the received signal, if any, at an automatically identified recording level.

17. The apparatus of claim 16, further comprising an audio analysis circuit, coupled to the input port and to the controller, operative to analyze primary audio content of the received signal, if any, to identify audio attributes of the primary audio content.

18. The apparatus of claim 17, wherein the audio analysis circuit is operative to select and supply to controller a recording level for the identified audio selection based, at least in part, on the identified audio attributes of the primary audio content.

19. The apparatus of claim 10, wherein the plurality of audio selections are stored in a remote audio system, communicatively coupled to apparatus through an audio interface, wherein the controller is operative to identify and retrieve appropriate audio selections from the remote audio system through the audio interface.

20. The apparatus of claim 10, wherein the plurality of audio selections are stored in a network server, communicatively coupled to the apparatus through a network connection, wherein the controller is operative to identify and retrieve appropriate audio selections from the network server through the network connection.

21. A video editing system comprising: an input port through which the editing system receives a signal having video content;

a video analysis circuit, coupled to the input port, operative to analyze the video content of the received signal to identify visual attributes of the video content; and

a controller, coupled to the video analysis circuit, operative to identify and retrieve an appropriate audio selection from a plurality of audio selections with which to augment the received signal based, at least in part, on the identified visual attributes of the video content.

22. The editing system of claim 21, further comprising a mass storage device, coupled to the controller, operative to store and retrieve each of the plurality of audio selections.

23. The editing system of claim 21, wherein the video analysis circuit is operative to quantify color visual attributes of the video content, lighting visual attributes of the video content and/or motion visual attributes of the video content.

24. The editing system of claim 21, wherein the controller is operative to mix the identified audio selection with primary audio content of the received signal, if any, at an automatically identified recording level.

25. The editing system of claim 21, further comprising an audio analysis circuit, coupled to the input port and to the controller, operative to analyze primary audio content of the received signal, if any, to identify audio attributes of the primary audio content.

26. The editing system of claim 25, wherein the audio analysis circuit is operative to select and supply to controller a recording level for the identified audio selection based, at least in part, on the identified audio attributes of the primary audio content.

27. The editing system of claim 21, wherein the plurality of audio selections are stored in a remote audio system, communicatively coupled to editing system through an audio interface, wherein the controller is operative to identify and retrieve appropriate audio selections from the remote audio system through the audio interface.

28. The editing system of claim 21, wherein the plurality of audio selections are stored in a network server, communicatively coupled to the editing system through a

network connection, wherein the controller is operative to identify and retrieve appropriate audio selections from the network server through the network connection.

29. An electronic appliance comprising:

a primary audio/video (A/V) functional unit, operative to supply a signal including video content; and

an adjunct video editing system, responsive to the primary A/V functional unit, the adjunct video editing system including

an input port, coupled to the primary A/V functional unit, for receiving the signal having video content,

a video analysis circuit, coupled to the input port, operative to analyze the video content of the received signal to identify visual attributes of the video content, and

a controller, coupled to the video analysis circuit, operative to identify and retrieve an appropriate audio selection from a plurality of audio selections with which to augment the received signal based, at least in part, on the identified visual attributes of the video content of the received signal.

30. The electronic appliance of claim 29, wherein the electronic appliance is a television.

31. The electronic appliance of claim 29, wherein the electronic appliance is a video recorder/playback device.

32. The electronic appliance of claim 29, wherein the adjunct video editing system further comprises an audio analysis circuit, coupled to the input port, operative to analyze primary audio content contained within the received signal, if any, to identify audio attributes of the primary audio content.

33. The electronic appliance of claim 32, wherein the audio analysis circuit identifies an appropriate recording level with which to augment the received signal with the identified audio selection based, at least in part, on the identified audio attributes of the primary audio content.

34. The electronic appliance of claim 29, wherein the adjunct video editing system is operative to augment the received signal with the identified audio selection to produce a composite audio/video (A/V) signal including at least the video content and the identified audio selection.

35. A machine readable medium having stored thereon a plurality of instructions for implementing video editing services, wherein the video editing services include a service for analyzing video content of a received signal to identify visual attributes of the video content, and a service for identifying an appropriate audio selection from a plurality of available audio selections with which to augment the video content of the received signal based, at least in part, on the identified visual attributes of the video content of the received signal.

36. The machine readable medium of claim 35, wherein the video editing services further include a service for analyzing primary audio content of the received signal, if any, to identify audio attributes of the primary audio content and, based at least in part, to identify an appropriate recording level with which to augment the received video recording with the identified audio selection.

37. The machine readable medium of claim 35, wherein the video editing services further include a service for augmenting the received signal with the

identified audio content to produce a composite audio/video (A/V) signal comprising at least the video content and the identified audio content.

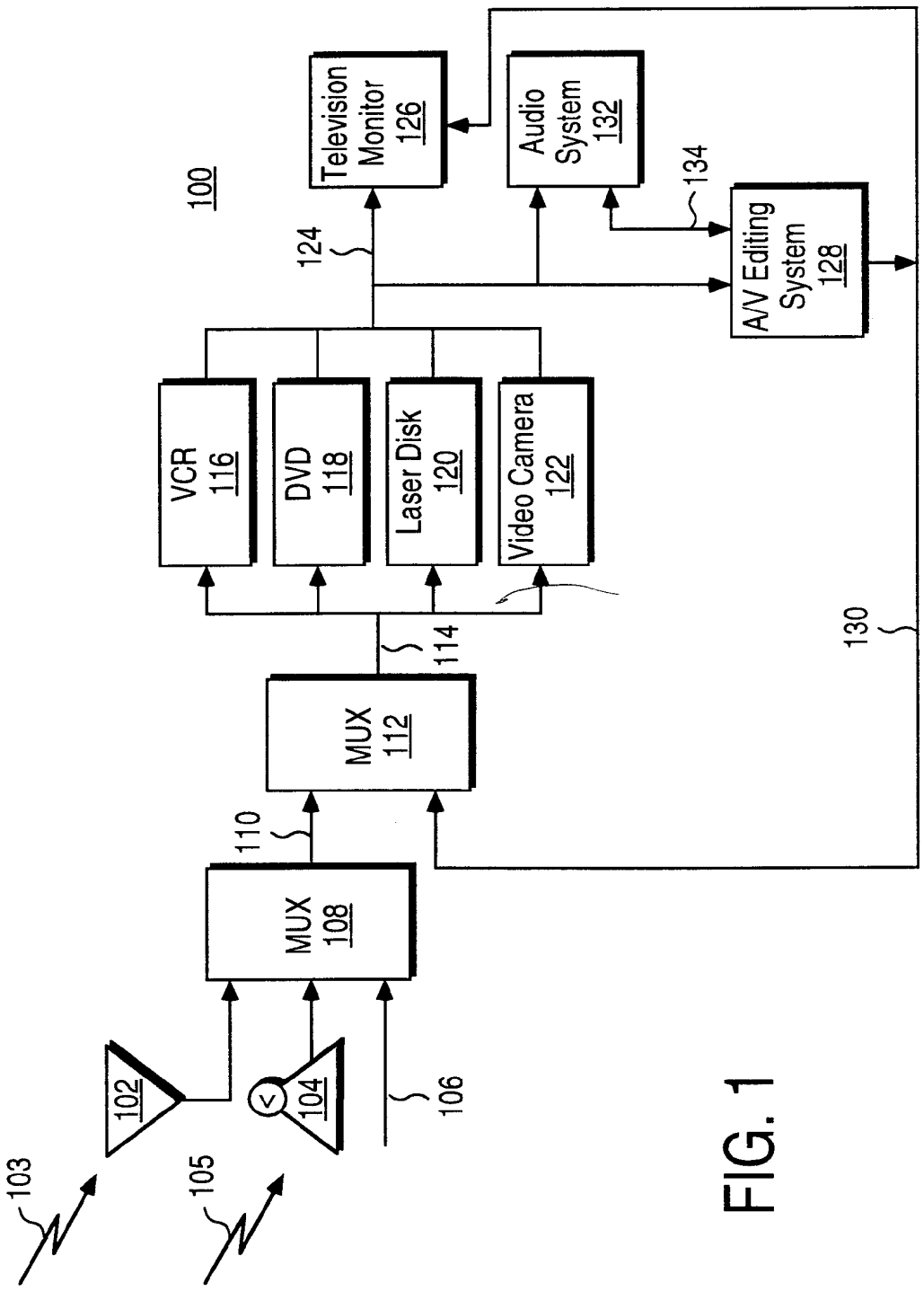

100
Television Monitor 126
Audio System 132
134
A/V Editing System 128
124
VCR 116
DVD 118
Laser Disk 120
Video Camera 122
114
130
MUX 112
110
MUX 108
102
104
106
103
105

FIG. 1

FIG. 2

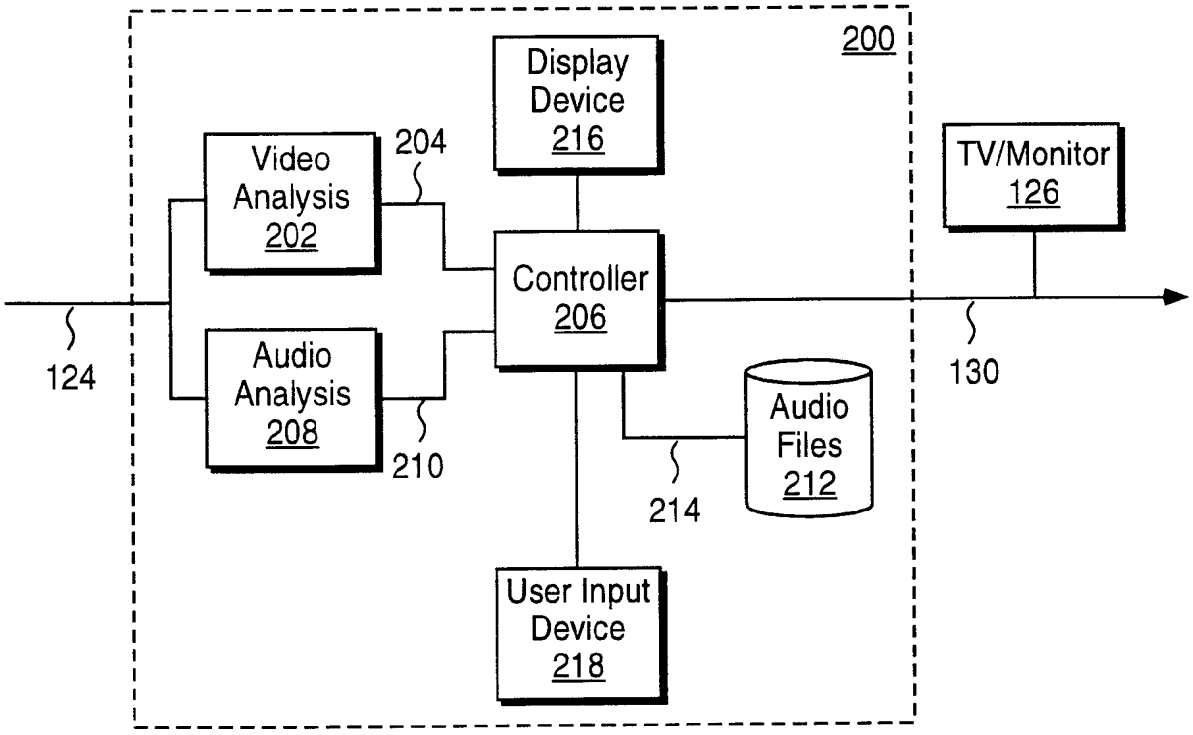

200
Display Device 216
Video Analysis 202
204
TV/Monitor 126
Controller 206
124
Audio Analysis 208
210
130
Audio Files 212
214
User Input Device 218

FIG. 3

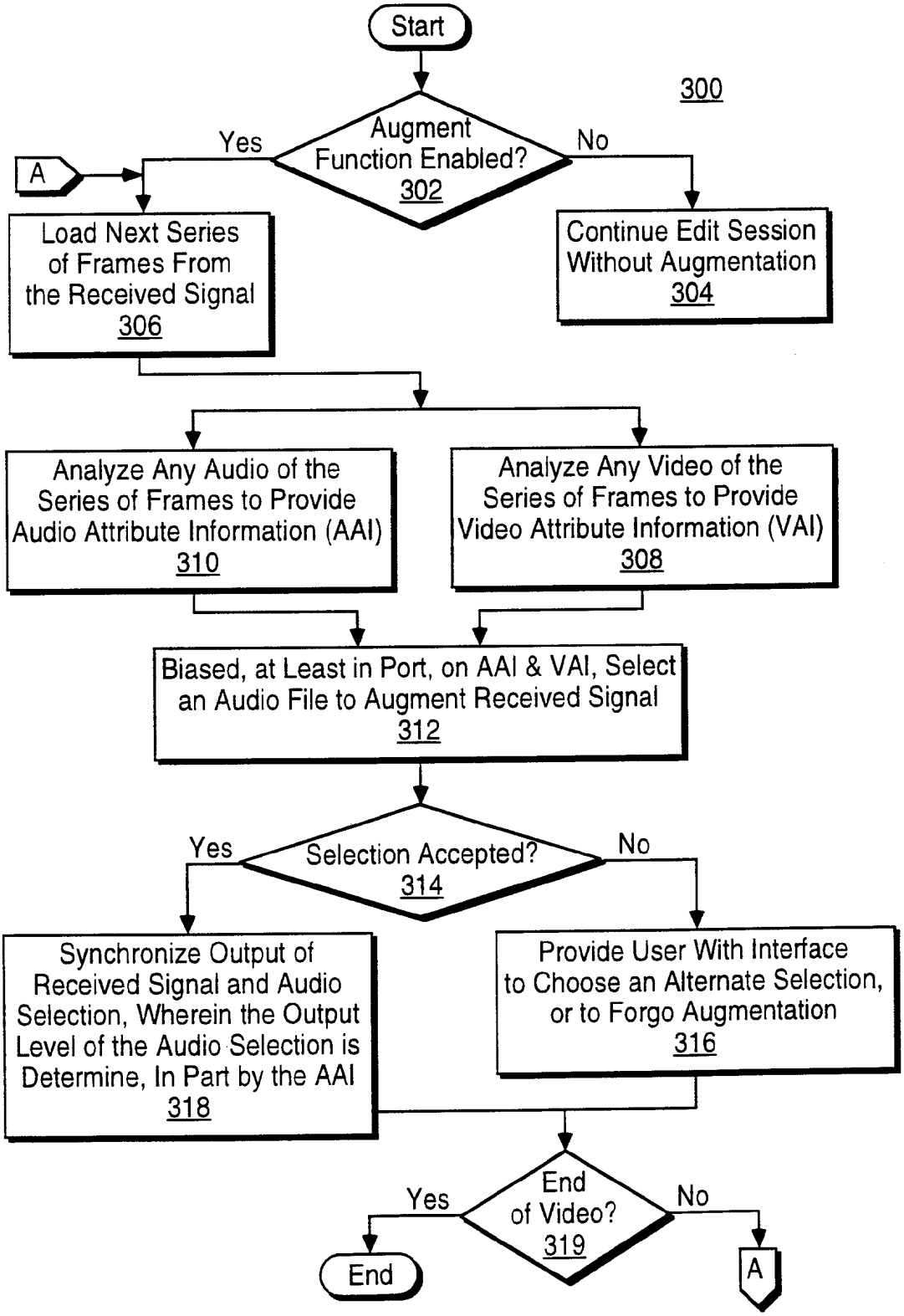

Start
300
Augment Function Enabled? 302
Yes
No
A
Load Next Series of Frames From the Received Signal 306
Continue Edit Session Without Augmentation 304
Analyze Any Audio of the Series of Frames to Provide Audio Attribute Information (AAI) 310
Analyze Any Video of the Series of Frames to Provide Video Attribute Information (VAI) 308
Biased, at Least in Port, on AAI & VAI, Select an Audio File to Augment Received Signal 312
Selection Accepted? 314
Yes
No
Synchronize Output of Received Signal and Audio Selection, Wherein the Output Level of the Audio Selection is Determine, In Part by the AAI 318
Provide User With Interface to Choose an Alternate Selection, or to Forgo Augmentation 316
End of Video? 319
Yes
No
End
A

FIG. 4

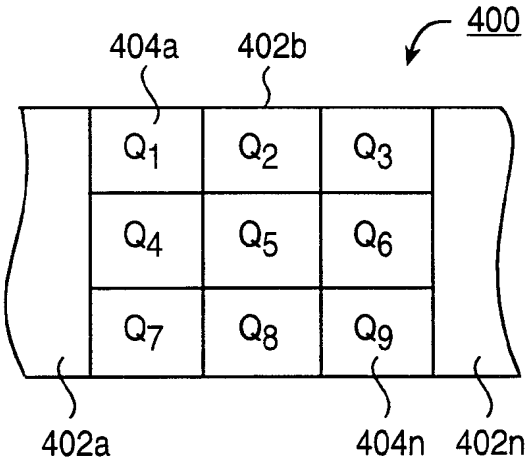
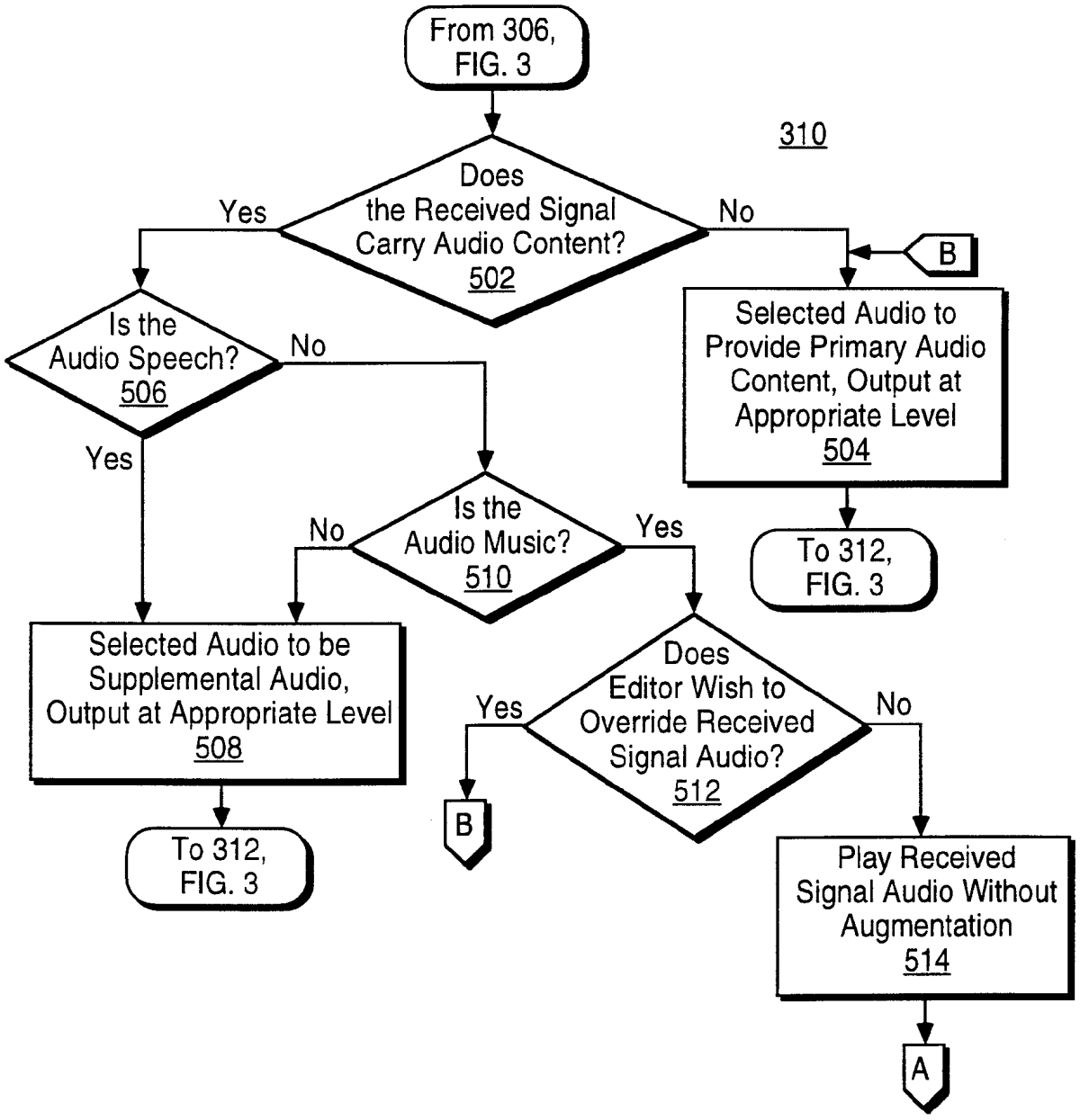


FIG. 5


From 306, FIG. 3
310
Does the Received Signal Carry Audio Content? 502
Yes
No
B
Selected Audio to Provide Primary Audio Content, Output at Appropriate Level 504
To 312, FIG. 3
Is the Audio Speech? 506
No
Yes
Is the Audio Music? 510
No
Yes
Selected Audio to be Supplemental Audio, Output at Appropriate Level 508
To 312, FIG. 3
Does Editor Wish to Override Received Signal Audio? 512
Yes
No
B
Play Received Signal Audio Without Augmentation 514
A

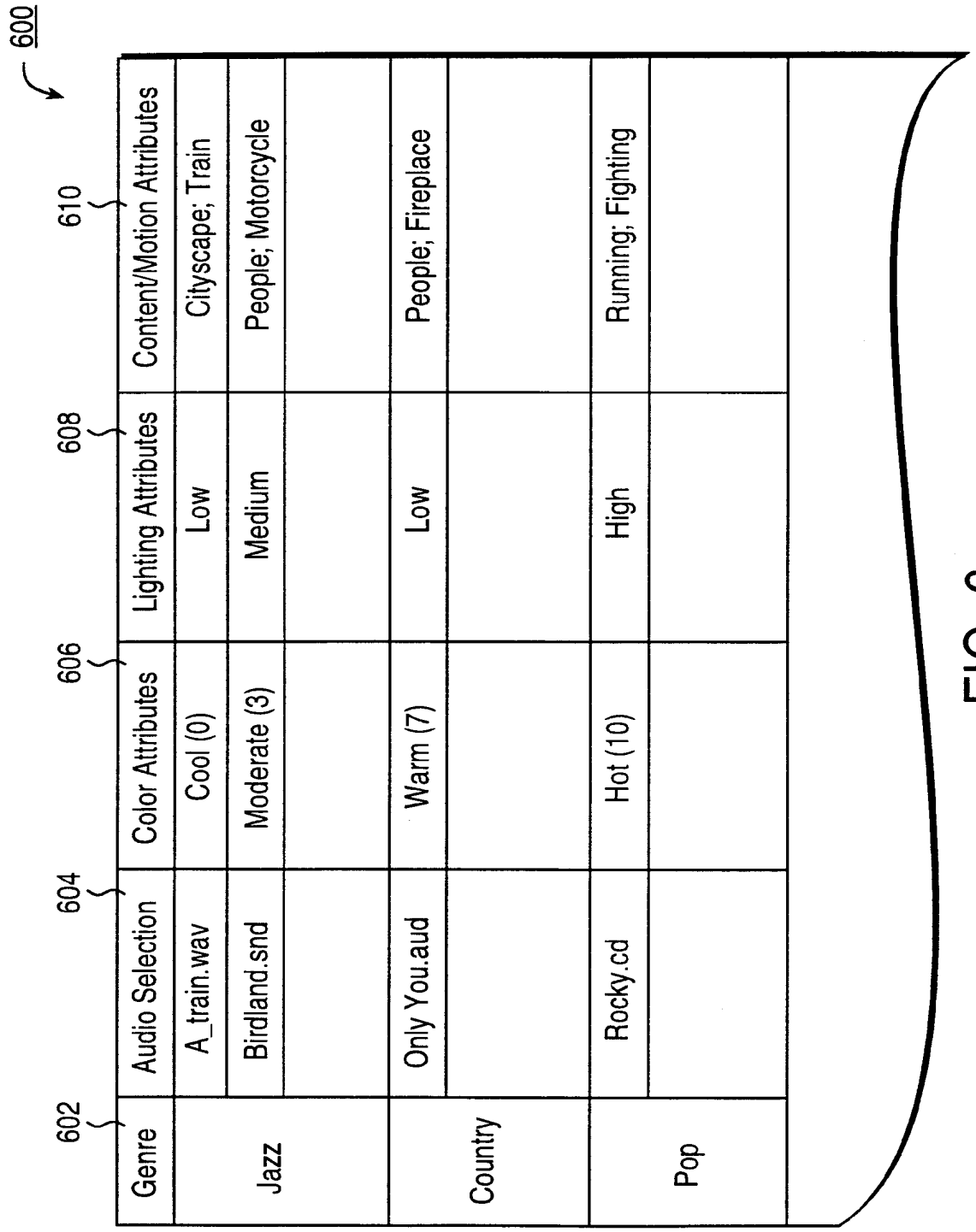

600
602
604
606
608
610
Genre
Audio Selection
Color Attributes
Lighting Attributes
Content/Motion Attributes
Jazz
A_train.wav
Cool (0)
Low
Cityscape; Train
Birdland.snd
Moderate (3)
Medium
People; Motorcycle
Country
Only You.aud
Warm (7)
Low
People; Fireplace
Pop
Rocky.cd
Hot (10)
High
Running; Fighting

FIG. 6

FIG. 7

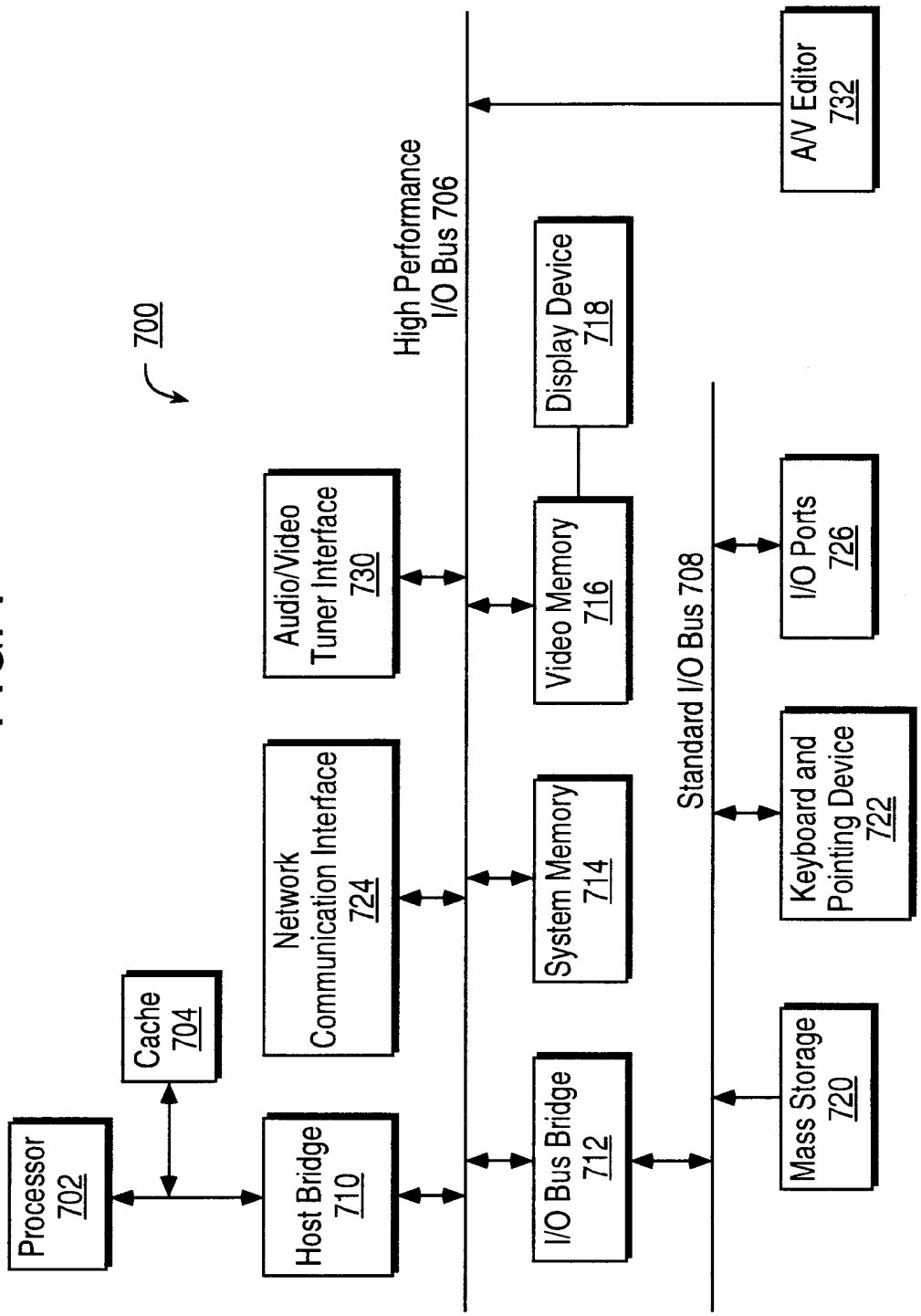
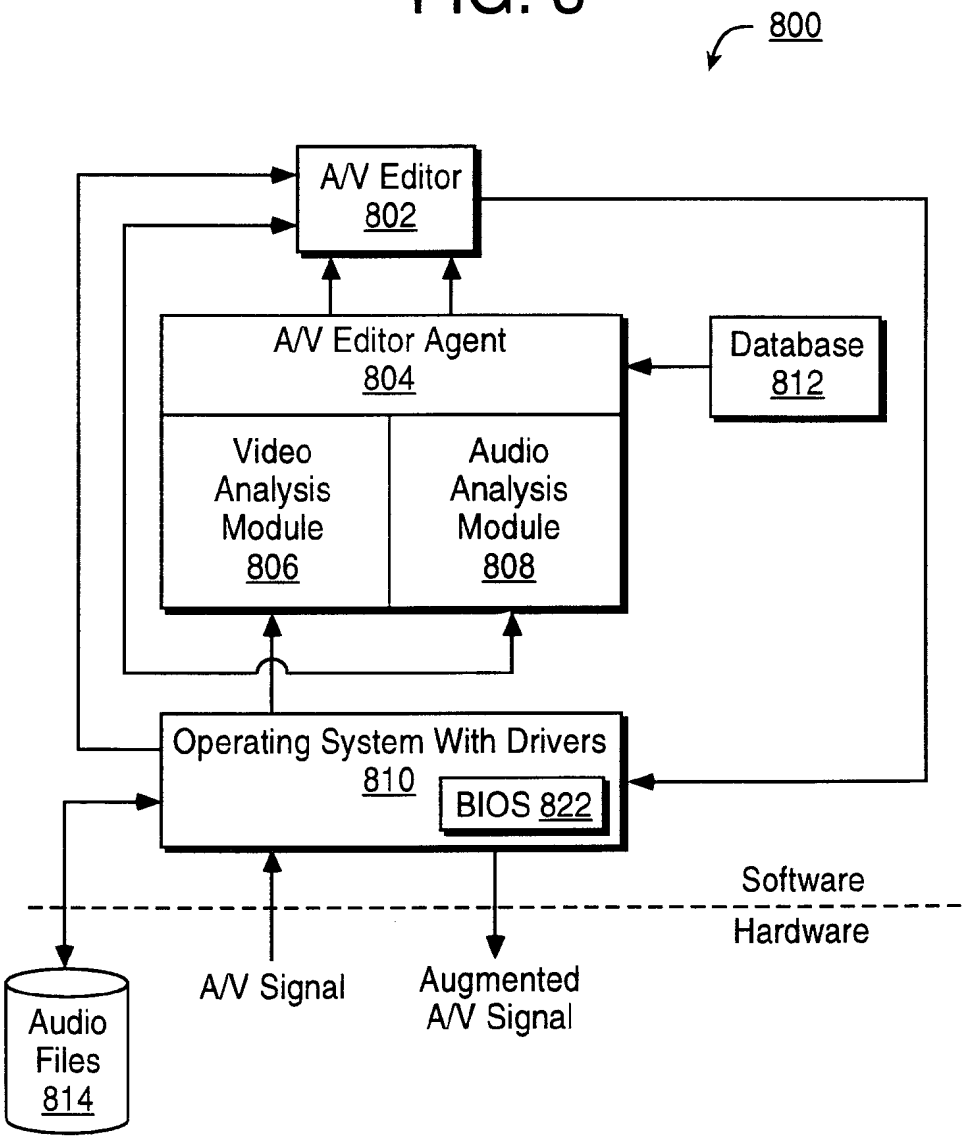

700
Processor 702
Cache 704
Host Bridge 710
Network Communication Interface 724
Audio/Video Tuner Interface 730
High Performance I/O Bus 706
System Memory 714
Video Memory 716
Display Device 718
A/V Editor 732
I/O Bus Bridge 712
Standard I/O Bus 708
Mass Storage 720
Keyboard and Pointing Device 722
I/O Ports 726

FIG. 8


800
A/V Editor
802
A/V Editor Agent
804
Database
812
Video
Analysis
Module
806
Audio
Analysis
Module
808
Operating System With Drivers
810
BIOS 822
Software
Hardware
Audio
Files
814
A/V Signal
Augmented
A/V Signal

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/02042

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :H04N 5/76
US CL :386/52

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 386/52, 53, 54, 64, 4; 348/515; 360/13; 369/83; 345/328

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X, E	US 5,852,438 A (TOMIZAWA et al) 22 December 1998, columns 12-13.	1-37
X	US 5,636,073 A (YAMAMOTO et al) 03 June 1997, Fig.2.	1-37
A	US 5,206,929 A (LANGFORD et al) 27 April 1993, Fig.2.	1-37
A	US 4,491,879 A (FINE) 01 January 1985, Fig.1.	1-37

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 26 MARCH 1999	Date of mailing of the international search report **11 May 1999**
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer THAI TRAN James R. Matthews Telephone No. (703) 305-4725

Form PCT/ISA/210 (second sheet)(July 1992)★